(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 385 498 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 90104100.4

(51) Int. Cl.5: G11B 7/09, G11B 7/00

(22) Date of filing: 02.03.90

(30) Priority: 03.03.89 JP 50094/89

(43) Date of publication of application:
05.09.90 Bulletin 90/36

(84) Designated Contracting States:
DE FR GB

(71) Applicant: SONY CORPORATION
7-35 Kitashinagawa 6-Chome Shinagawa-ku
Tokyo 141(JP)

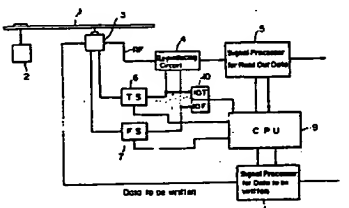
(72) Inventor: Shinkai, Hiroyuki
c/o Sony Corporation, 7-35 Kitashinagawa
6-chome
Shinagawa-ku, Tokyo(JP)
Inventor: Wachi, Shigeaki
c/o Sony Corporation, 7-35 Kitashinagawa
6-chome
Shinagawa-ku, Tokyo(JP)
Inventor: Tosaka, Susumu
c/o Sony Corporation, 7-35 Kitashinagawa
6-chome
Shinagawa-ku, Tokyo(JP)
Inventor: Okawa, Sumihiro
c/o Sony Corporation, 7-35 Kitashinagawa
6-chome
Shinagawa-ku, Tokyo(JP)

(74) Representative: Schmidt-Evers, Jürgen,
Dipl.-Ing. et al
Patentanwälte Mitscherlich, Gunschmann
Dr. Körber, Schmidt-Evers, Melzer, Dr. Schulz
Steinsdorfstrasse 10
D-8000 München 22(DE)

(54) Recording and reproducing apparatus for optical disk.

(57) The present invention relates to an optical recording and reproducing apparatus comprising an erroneous recording prevention means which prevents this apparatus from making an erroneous recording or erasing operation while it records data on a writable disk (1). The apparatus is arranged such that, while it is performing a recording or erasing operation, a state of its beam of light just about to go off the control point of tracking and a state of its beam of light just about to go off the control point of focusing are each monitored and, when either of the states is detected, the recording or erasing operation is canceled. Hence, laser power of the beam of light can be controlled before the beam of light completely goes off the control point of tracking, thereby preventing the beam of light from affecting data having been recorded along other tracks.

FIG. 1



EP 0 385 498 A2

RECORDING AND REPRODUCING APPARATUS FOR OPTICAL DISK

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a recording and reproducing apparatus for optical disk capable of recording data on an optical disk and reading the data therefrom and, more particularly, relates to an erroneous recording prevention means for preventing the apparatus from making an erroneous recording/erasing operation while writing data.

Description of the Prior Art

An optical disk, which is provided with a recording medium, whose reflectance varies in response to light, formed on a recording surface of the optical disk and thereby enabled to record information and allow the information to be reproduced, is in practical use.

Such optical disk of an overwritable type is provided, for example, with a spiral track divided into n sectors S_{C1}, S_{C2}, S_{C3}, ... , S_{Cn} as shown in FIG. 4, each sector having an address region AD_1, AD_2, AD_3, ... at the head portion thereof to record a piece of track address data therein. It is adapted such that, by irradiating the data recording area of each sector S_{C1}, S_{C2}, S_{C3}, ... by a laser beam modulated with recording data, temperature at the irradiated portion is sharply elevated so that recording dots are formed there, or by throwing a laser beam weaker than that used at the time of recording on the recorded area, the information is read out.

Thus, it is arranged such that the laser beam irradiating the optical disk in the recording/erasing mode is provided with laser power several times as high as that for the laser beam in the reading mode. Hence, when the optical recording and reproducing apparatus in the recording/erasing mode was subjected to a strong vibration causing the laser beam to go off the recording/erasing track, such serious accidents sometimes occurred that the data already written in were destroyed or new data, were written along a wrong track of the optical disk.

Therefore, it has been considered to provide the apparatus with a means which monitors a tracking error signal and, when a detrack state is detected in

The recording mode, to stop the writing operation at once, thereby preventing the erroneous recording or erroneous erasing of data.

With the erroneous recording preventing device as described above, however, it sometimes occurs that the laser beam has already deviated a great degree from the on-track position when a detrack state is detected. Thus, there has been a problem with it that positive prevention of the erroneous recording/erasing cannot be assured.

More particularly, when the recording and reproducing apparatus for optical disk is subjected to a strong shock, the focus servo sometimes comes off the control point, or it becomes unstable, before or at the same time as the detrack occurs. Then, the level of the tracking error signal itself may have already been lowered. Therefore, even if the tracking error signal is constantly monitored by a level comparison means or the like, it may be difficult to correctly detect occurrence of the detrack.

Further, when an out-of-focus state is brought about in the recording mode or erasing mode, the laser beam converged on the optical disk may be spread to cover other track regions and, hence, problems occur that the recorded data on the optical disk are destroyed and, in the reading mode, many error data are produced.

SUMMARY OF THE INVENTION

The present invention was made in view of these problems in the prior art, and accordingly, a primary object of the present invention is to provide an optical recording and reproducing apparatus in which erroneous recording and erroneous erasing are prevented from occurring.

It is another object of the present invention to provide an optical recording and reproducing apparatus in which destruction of data recorded along other tracks are prevented from occurring.

It is a further object of the present invention to provide an optical recording and reproducing apparatus adapted to stop its data recording operation before the recording beam comes off the track completely.

To achieve the above enumerated objects, the optical recording and reproducing apparatus according to the present invention comprises a detrack detection means for detecting a state of the level of a tracking error signal having gone outside a predetermined range and a defocus detection means for detecting a state of the level of a focus error signal having gone outside a predetermined range, wherein it is arranged such that, if either of the above two states is detected while the apparatus is performing a data recording or erasing operation, the recording or reproducing operation is

caused to stop.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram showing an outline of an optical recording and reproducing apparatus according to the present invention;

FIG. 2(a) and FIG. 2(b) are explanatory drawings of a tacking error signal;

FIG. 3 is a circuit diagram showing an example of detrack and defocus detection means; and

FIG. 4 is an explanatory drawing of a writable optical disk.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 is a block diagram showing the principal portion of a recording and reproducing apparatus for optical disk of the present invention, in which an optical disk 1 is rotationally driven by a spindle motor 2.

An optical head 3 throwing a laser beam on the optical disk 1 and enabled to write data on it and also read out data written on the optical disk 1 is provided, as well known, with such parts as a laser beam source, an optical element for permitting the laser beam to converge on a recording surface of the optical disk 1, and a photosensor for detecting a reflected beam from tile optical disk 1. It is further provided with a focus actuator to cause the converged laser beam to irradiate the optical disk 1 at the focal spot and a tracking actuator (not shown) to move the laser beam so as to follow the track of the optical disk 1.

An RF reproducing circuit portion 4 amplifies a reproduced RF signal obtained from the optical head 3 and, at the same time, extracts a tracking error signal and a focus error signal from the reproduced RF signal and a read out signal processor 5 performs signal processing of reproduced data.

The tracking error signal detected by the RF reproducing circuit portion 4 is supplied to the tracking actuator through a tracking servo circuit 6 and, likewise, the focus error signal is supplied to the focus actuator through a focus servo circuit 7.

A signal processor for data to be written 8, at the time of recording, converts data into a predetermined code end supplies it to the optical head 3 in synchronism with a timing clock and a control unit (CPU) 9 performs controlling for various signals according to recording, reproducing, and erasing modes of the optical disk.

A beam detection means 10 is made up of a detrack detection means 10T for detecting a detecting a defocus state, and the two detection means are each provided with a comparator for comparing the level of a reference voltage and the error signal as described later.

The optical disk of the present invention is enabled to prevent occurrence of erroneous erasing and erroneous recording by virtue of the above mentioned beam detection means 10 as described below.

The tracking error signal or the focus error signal generally varies in an S-shaped curve as described, for example, in U.S. Pat. Nos. 4,502,134 and 4,059,841. As shown in FIG. 2(a) and FIG. 2-(b), for example, the value of the tracking error signal becomes zero when the position of a light beam S thrown on a track G of an optical disk is in an on-track state S_1, the tracking error signal exhibits its maximum error value in a state S_2 where the light beam S is one fourth the track pitch Q, i.e., Q/4, off the on-track position, and it again becomes zero when the light beam S is brought to a state S_3 in the middle of the track pitch Q, i.e., Q/2 off the on-track position.

Then, by providing, as shown in FIG. 3, the detrack detection means 10T so that the tracking error signal et is input through an AGC amplifier to two comparators Ct1 and Ct2 thereof for comparison with reference voltages Et1 (+) and Et2 (-) which are smaller than the maximum error signal, the detrack state of the laser beam can be detected before it goes Q/4 off the on-track position.

Likewise, by providing the defocus detection means 10F so that the focus error signal ef is input through an AGC amplifier to two comparators Cf1 and Cf2 thereof for comparison with reference voltages Ef1 (+) and Ef2 (-), which are slightly smaller than the focus error signal at the time just before the beam is brought to a defocus state, the state of the focus servo immediately before going off the control point can be detected.

Outputs of the two detection means 10T and 10F are passed through an AND gate 11 to provide a logical product output, which is then input to a NAND gate 12.

The other input to the NAND gate 12 is held at the H level in the recording or erasing mode and, hence, when a signal is detected in either of the detrack and defocus detection means during the recording/erasing mode, the Q terminal of a flip-flop circuit 13 goes to the H level, whereby the control unit 9 cancels the recording/erasing mode of the recording and reproducing apparatus for optical disk.

Further, at the same time as the cancellation of the recording/erasing mode, the optical recording and reproducing apparatus is forcedly brought to the reading mode.

ing the optical disk 1 is lowered so that the recorded data on the optical disk can be protected.

When converted to the reading mode, the apparatus monitors the address signal. If the state where the address signal is normally output is restored, it means that the servo circuit has restored its normal operating status. Thereupon, the apparatus is returned to the original writing or erasing mode by a reset signal output from the control unit 9.

In the optical recording and reproducing apparatus of the present invention as described in the foregoing, both of the tracking error signal and the focus error signal are monitored by the detrack detection means and the defocus detection means, and control is performed such that, when a signal is output from either of these detection means, the recording/erasing mode is canceled, or the optical recording and reproducing apparatus is forced to change its mode to the reading mode. Therefore, it is ensured that the laser power is lowered when the detrack occurs while the apparatus is in the recording or erasing mode, whereby such effects are obtained that data already recorded can be protected and data to be recorded are positively recorded at a predetermined track address.

Claims

1. An optical recording and reproducing apparatus capable of recording and erasing data on a writable optical disk comprising:
focus servo means (7) having focus error detection means and using its output for focus servo control of a beam of light;
tracking servo means (6) having tracking error detection means and using its output for tracking servo control of the beam of light;
detrack detection means (10T) for detecting a state of the level of said tracking error signal having gone outside a predetermined range;
defocus detection means (10F) for detecting a state of the level of said focus error signal having gone outside a predetermined range; and
control means (9), while said apparatus is in a mode of recording or erasing data, for cancelling said recording or erasing mode when either of said detrack or defocus state is detected.

2. An optical recording and reproducing apparatus according to claim 1, wherein said detrack detection means (10T) detects a detrack state by comparing said tracking error signal with a positive and a negative reference level smaller than a maximum error signal.

3. An optical recording and reproducing apparatus according to claim 1 or 2, wherein said defocus detection means (10T) detects a defocus state by comparing said focus error signal with a positive and a negative reference level smaller than a maximum error signal.

4. An optical recording and reproducing apparatus according to anyone of claims 1 to 3, wherein said apparatus further comprises drive control means which, while said apparatus is in a mode of recording or erasing data, changes the mode to a mode capable of reproducing data when either of said detrack and defocus states is detected.

5. An optical recording and reproducing apparatus according to claim 4, wherein said drive control means controls laser power of said beam of light.

6. An optical recording and reproducing apparatus according to claim 4 or 5, wherein said apparatus further comprises
address monitor means for detecting that the mode has been changed by said drive control means to the mode capable of reproducing data and, thereupon, detecting an address signal recorded on said disk; and
means for detecting that said address signal is normally obtained by said address monitor means and, thereupon, resetting the mode to the mode capable of recording or erasing.

FIG. 1

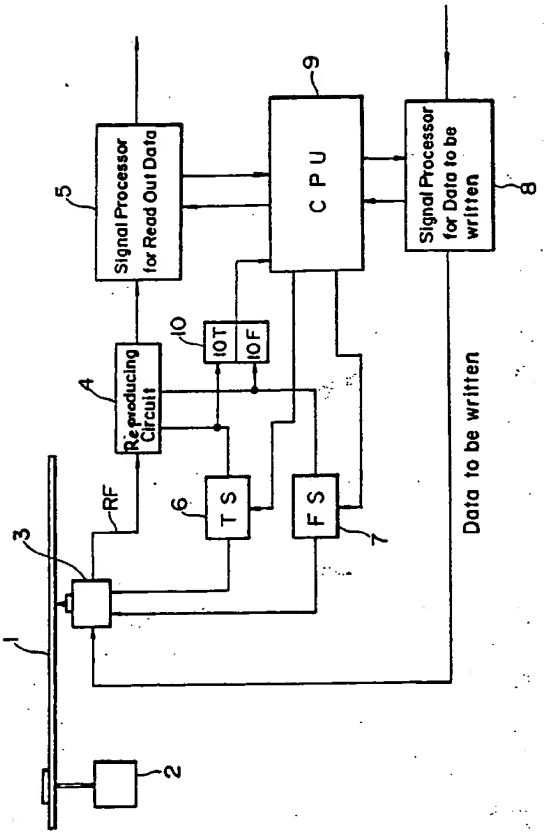

1
2
3
RF
4
Reproducing Circuit
5
Signal Processor for Read Out Data
6
T S
7
F S
8
Signal Processor for Data to be written
9
C P U
10
10T
10F
Data to be written

FIG.3

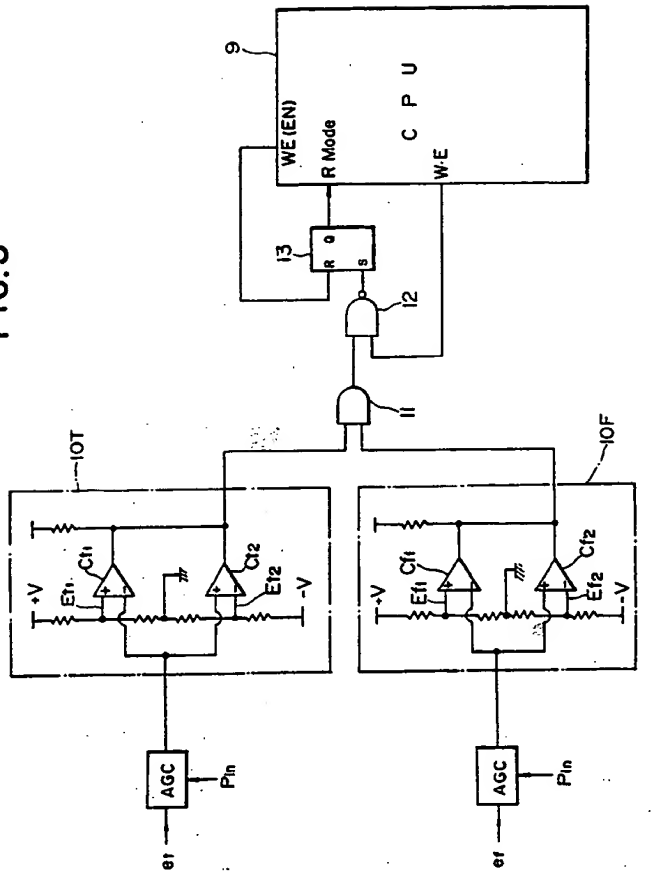

9
CPU
WE(EN)
R Mode
W·E
13
R
Q
S
12
11
10T
10F
+V
-V
Et1
Ct1
Ct2
Et2
Ef1
Cf1
Cf2
Ef2
AGC
Pin
e1
e1

FIG. 2(a)

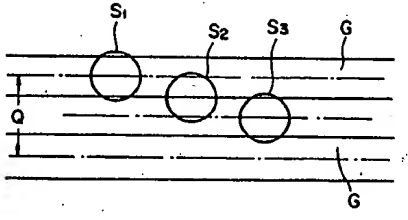


FIG. 2(b)

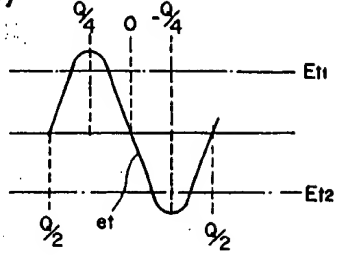
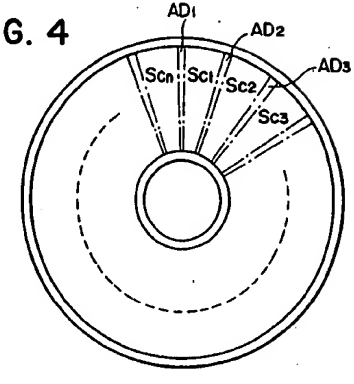


FIG. 4



EP 0 385 498 A2

FIG. 2(a)

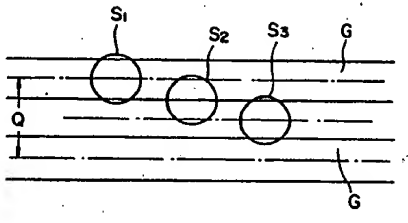


FIG. 2(b)

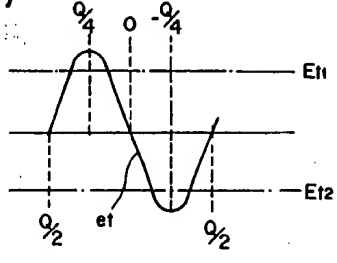
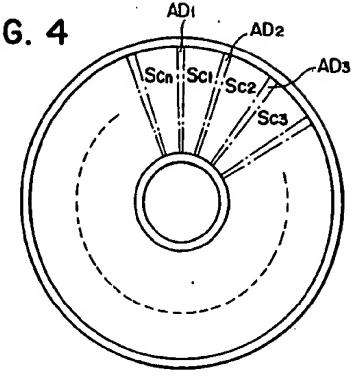


FIG. 4



EP 0 385 498 A2

(11) Publication number: **0 385 498 A3**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 90104100.4

(22) Date of filing: 02.03.90

(51) Int. Cl.5: G11B 19/04, G11B 7/09, G11B 7/00

(30) Priority: 03.03.89 JP 50094/89

(43) Date of publication of application: 05.09.90 Bulletin 90/36

(84) Designated Contracting States: DE FR GB

(88) Date of deferred publication of the search report: 27.12.91 Bulletin 91/52

(71) Applicant: SONY CORPORATION
7-35 Kitashinagawa 6-Chome Shinagawa-ku
Tokyo 141(JP)

(72) Inventor: Shinkai, Hiroyuki
c/o Sony Corporation, 7-35 Kitashinagawa
6-chome
Shinagawa-ku, Tokyo(JP)

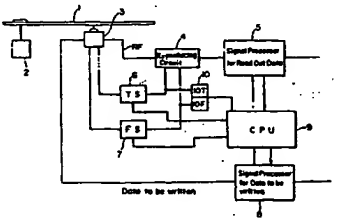
Inventor: Wachi, Shigeaki
c/o Sony Corporation, 7-35 Kitashinagawa
6-chome
Shinagawa-ku, Tokyo(JP)
Inventor: Tosaka, Susumu
c/o Sony Corporation, 7-35 Kitashinagawa
6-chome
Shinagawa-ku, Tokyo(JP)
Inventor: Okawa, Sumihiro
c/o Sony Corporation, 7-35 Kitashinagawa
6-chome
Shinagawa-ku, Tokyo(JP)

(74) Representative: Schmidt-Evers, Jürgen, Dipl.-Ing. et al
Patentanwälte Mitscherlich, Gunschmann
Dr. Körber, Schmidt-Evers, Melzer, Dr. Schulz
Steinsdorfstrasse 10
W-8000 München 22(DE)

(54) Recording and reproducing apparatus for optical disk.

(57) The present invention relates to an optical recording and reproducing apparatus comprising an erroneous recording prevention means which prevents this apparatus from making an erroneous recording or erasing operation while it records data on a writable disk (1). The apparatus is arranged such that, while it is performing a recording or erasing operation, a state of its beam of light just about to go off the control point of tracking and a state of its beam of light just about to go off the control point of focusing are each monitored and, when either of the states is detected, the recording or erasing operation is canceled. Hence, laser power of the beam of light can be controlled before the beam of light completely goes off the control point of tracking, thereby preventing the beam of light from affecting data having been recorded along other tracks.

FIG. 1



EP 0 385 498 A3